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Analysis of patients admitted to the emergency department with gunshot wounds

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Ethics Committee Approval
This study was approved by the Ethical Committee of Afyonkarahisar Health Sciences University, Faculty of Medicine (2020/449).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: The incidence and nature of gunshot wounds differ between countries, and they are a prominent cause of mortality and morbidity. The primary assessment and treatment of patients with gunshot wounds in the emergency department are often highly complex. In this study, we aimed to investigate the effect of clinical findings and trauma scores on patient prognosis and mortality of patients who applied to the emergency department with gunshot wounds.
Methods: In this retrospective cohort study, records of patients with gunshot wounds were accessed from the archive. Patients' age, gender, time of admission to the emergency department, injured body regions, image reports, hospitalization status and mortality rates were analyzed. The Glasgow Coma Scale (GCS), Revised Trauma Score (RTS), Injury Severity Score (ISS) and Trauma and Injury Severity Score (TRISS) rates were calculated for all patients to predict prognosis.
Results: Most injuries (50.8%) and the highest mortality (66.7%) occurred between 16:01 and 24:00. The most common injuries were lower extremity injuries (63.9%) and upper extremity injuries (47.5%). The mean GCS, RTS, and ISS were 13 (3.6), 7.07 (2.23), and 12.36 (10.48), respectively, and the mean TRISS survival probability for penetrating trauma was 88.59%. Eighteen patients (29.5%) were treated and discharged from the emergency department, nineteen (31.2%) were admitted to the wards and 9 patients (14.8%), to the intensive care unit. In patients who died, GCS, RTS, and TRISS were significantly lower than in surviving patients, and the ISS was statistically significantly higher ($P<0.001$). Mortality rate was 9.8%.
Conclusion: Gunshot wounds can cause serious injuries associated with high mortality, especially in the head, chest, and abdomen. GCS, ISS, RTS and TRISS trauma score systems will be useful in predicting prognosis and mortality rates in gunshot wounds.

Keywords: Gunshot wounds, Glasgow coma scale, Injury severity score, Revised trauma score, Trauma and injury severity score

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Introduction

Gunshot wounds are one of the most important traumas affecting mortality and morbidity. Especially with the industrial development of firearms in the second half of the nineteenth century, the incidence of gunshot wounds increased worldwide [1, 2]. With the easy availability of firearms, mortality rates due to gunshot wounds are increasing in our country as well. The bullet rotates and advances along its rotation, which may lead to more serious injuries than the physician initially suspects [3]. Gunshot wounds can cause high morbidity and mortality due to concomitant organ and vascular injuries [1, 2].

In the emergency department (ED), the trauma patient who was seriously injured by a firearm should be evaluated and intervened rapidly for airway obstruction, tension pneumothorax, massive internal or external hemorrhage, open pneumothorax, flail chest, and cardiac tamponade [4].

Trauma scoring systems are used in emergency situations to provide fast and accurate triage to trauma patients and predict mortality. These scoring results provide information about the course of the disease and affect the treatment of the casualty. Trauma scores are calculated according to age, anatomical injury, and physiological findings [5].

This study aimed to examine the effects of clinical findings and trauma scores on prognosis and mortality by examining the patients who were admitted to the ED with gunshot wounds.

Materials and methods

This retrospective cohort study was approved by the Ethical Committee of Afyonkarahisar Health Sciences University, Faculty of Medicine (2020/449 on 02/10/2020). Among 2601 forensic cases admitted to the ED of Afyonkarahisar Health Sciences University between 01.11.2019-01.11.2020, sixty-one (aged 0-90 years) were admitted to the emergency department with gunshot wounds. The patients' age, gender, time of admission to the ED, injured body regions, image reports, hospitalization status, trauma scores and mortality rates were retrospectively examined from the archive and analyzed.

Glasgow coma score (GCS) is a scoring system that helps evaluate consciousness after head trauma and predict of the prognosis in the preliminary period [6,7].

The Injury Severity Score (ISS) allows evaluation of the severity of existing lesions according to the anatomical region. The score ranges from 0 to 75. Traumas which score over 15 points in the ISS are considered severe [8].

Revised Trauma Score (RTS) is a scoring system that includes GCS, systolic blood pressure (SBP) and respiratory rate (RR). It is calculated with the formula RTS = (0.9368 x GCS) + (0.7326 x SBP) + (0.2908 x RR) and results in a score between 0-7.8408 [9].

Trauma and Injury Severity score (TRISS) is calculated using the ISS and the patient's age [10].

GCS, RTS, ISS and TRISS rates were calculated for all patients to predict prognosis.

Statistical analysis

Statistical analysis of the study was performed using SPSS version 22.0. The data were presented as mean, standard deviation and percentages. The Kolmogorov Smirnov test was used to determine the conformity of the data to normal distribution, which revealed that the data was non-normally distributed. Mann Whitney U test was used for pairwise group comparisons in which significant differences between measurements were evaluated, and Kruskal Wallis Test was used for multi-group comparisons. The results were evaluated at a 95% confidence interval, and P <0.05 was considered statistically significant.

Results

Sixty-one patients (95.1% male, 4.9% female) were admitted to the emergency department after a gunshot wound within one year. The mean age of all patients was 35.5 years (range: 5-87 years). Most events (50.8%) and the highest mortality (66.7%) occurred between 16:01-24:00. Gunshot wounds were most seen in November (16.4%). No significant relationship was detected between age and mortality (P=0.531, r=-0.063).

The most common injury sites of gunshot wounds were lower (n=39, 63.9%) and upper extremity injuries (n=29, 47.5%). More than one area of injury was seen in 25 (41%) patients.

The average trauma scores were calculated for all patients. The mean GCS, RTS, and ISS were 13 (3.6) (range: 3-15), 7.07 (2.23) (range: 0-7.84), and 12.36 (10.48) (range:1-54), respectively, and the mean TRISS survival probability for penetrating trauma was 88.59% (range: 0.24-99.45%). In patients who died, GCS, RTS and TRISS were significantly lower, and ISS was significantly higher compared to surviving patients (P<0.001). In total, nineteen patients had severe injury, hence an ISS of above 15 points. ISS of six patients who died ranged between 25-54.

The first blood test results of the patients admitted to the ED with gunshot wounds are given in Table 1. Ten patients required erythrocyte suspension transfusion. Forty-one patients (67.2%) had their blood alcohol levels measured in the ED, and four patients were found to have consumed alcohol. All cases (n=61) were reported to the judicial authorities.

Table 1: The first admission blood test results in the emergency department

Value	Median (min-max)	Mean (SD)
BUN (mg/dl)	15 (6.54-49.5)	18.26 (8.71)
Creatinine (mg/dL)	0.90 (0.28-1.5)	1.17 (1.87)
Sodium (mmol/L)	140 (133-150)	137.31 (19.54)
Chloride (mmol/L)	104 (94-118)	104.81 (4.37)
Potassium (mmol/L)	4.3 (2.2-7)	4.38 (0.77)
Calcium (mg/dL)	8.98 (7-10.8)	9.07 (0.76)
AST (U/L)	25.75 (10-381)	37.32 (50.67)
ALT (U/L)	19.4 (7-364)	31.68 (51.78)
Amylase (U/L)	49 (22-134)	53.11 (51.78)
APTT (sec)	25.30 (15.4-47.9)	26.88 (5.97)
WBC (10^3/uL)	13.18 (1.48-32.49)	13.52 (5.52)
Hb (g/dl)	13.60 (7-17.8)	13.49 (2.34)
PLT (10^3/uL)	227 (72-374)	229.81 (65.86)

BUN: Blood Urea Nitrogen, AST: Aspartate Aminotransferase, ALT: Alanine Transaminase, APTT: Activated Partial Thromboplastin Time, WBC: White Blood Cells, Hb: Hemoglobin, PLT: Platelet, SD: Standard Deviation

Extremity fractures and bullet fragments were detected by radiological methods. There were fractures in the upper and lower extremities in 4 and 15 patients, respectively. Bullet fragments were detected in the upper extremities of 16 patients, the lower extremities of 10 patients, the head and face of six patients, the thorax of five patients, and the abdomen of three patients. Six patients had severe vascular injury (arterial injury), three had nerve injury, two had tendon injury, one had an amputated phalanx, one had a subarachnoid hemorrhage, and four patients had severe abdominal injury.

Consultations from other departments were requested for 53 patients (86.9%), but no consultation was needed for eight patients (13.1%). Most consultations were made to the Orthopedics & Traumatology Department (42.7%), (Table 2). Eighteen patients (29.5%) were treated and discharged from the ED, nineteen patients (31.2%) were hospitalized in the wards and nine patients (14.8%) were transported to the intensive care unit (ICU). Most patients were hospitalized in the Department of Orthopedics & Traumatology. Cardiopulmonary resuscitation was performed in five patients in the ED. Six patients (9.8%) died (four in the ED, one in the ICU and one in the operating room) within 24 hours (Table 2).

The GCS, RTS, ISS and TRISS of the patients hospitalized in the ward and the ICU significantly differed (P=0.036, P=0.039, P=0.009, and P=0.014, respectively). Patients admitted to the ICU had lower GCS, RTS and TRISS scores and higher ISS than those admitted to the ward (Table 3).

Table 2: Distribution of consulted specialties and hospitalization

		n	%
Distribution of consulted specialties	Orthopedic & Traumatology	41	42.7
	Plastic surgery	16	16.6
	Neurosurgery	11	11.5
	Cardiovascular surgery	9	9.4
	General surgery	8	8.3
	Thoracic surgery	4	4.2
	Others *	7	7.3
	Total	96	100
Distribution of hospitalization	Discharge from ED	18	29.5
	Hospitalized in service	19	31.2
	Hospitalized in ICU	9	14.8
	Treatment refusal	5	8.2
	Refer to another hospital	4	6.5
	Exitus	6	9.8
	Total	61	100

*Urology (2), ophthalmology (1), anesthesia (1), cardiology (1), gynecology (1), pediatric surgery (1). ICU: Intensive Care Unit, ED: Emergency Department.

Table 3: Hospitalization and scores

	Hospitalization N (%)	Hospitalized in service 19 (31.2%)	Hospitalized in ICU 9 (14.8%)	P-value
GCS	Median (min-max)	15 (15-15)	15 (3-15)	0.036
	Mean (SD)	15 (0)	13 (3.97)	
RTS	Median (min-max)	7.84 (7.55-7.84)	7.84 (2.93-7.84)	0.039
	Mean (SD)	7.83 (0.7)	7.05 (1.63)	
ISS	Median (min-max)	9 (4-19)	17 (8-32)	0.009
	Mean (SD)	10.7 (5.08)	19.7 (7.92)	
TRISS (%)	Median (min-max)	98.87 (96.24-99.33)	96.66 (8.41-99.13)	0.014
	Mean (SD)	98.56 (0.86)	84.34 (29.34)	

ICU: Intensive Care Unit, SD: Standard Deviation

Discussion

Due to the easy availability and portability of firearms, morbidity, and mortality rates due to gunshot wounds are increasing in our country as well as in the world [4]. The physician's recognition of the characteristic wound patterns in the trauma patient who was severely injured by a firearm in the ED can speed up the treatment. The diagnosis of the anticipated injuries is supported by imaging [11, 12].

Compatible with the literature, in this study, the patients who presented to the ED with gunshot wounds were young males aged 30-40 years [1, 3, 4, 13]. The average age of the patients who died was 28 years, and no significant relationship was detected between age and mortality (P=0.531, r=-0.063). The gunshot wounds mostly occurred between 18:00-24:00 [1,4]. Similarly, in this study, most of the gunshot wounds (50.8%) and highest mortality rate (66.7%) were observed between 16:01-24:00. Factors that determine rates of firearm violence vary by country [14], and include illicit drug trafficking, access to firearms, substance abuse including alcohol, mental health problems, firearm laws, and social and economic differences [14, 15]. Where guns are more common, controversy results in more deaths [16]. We attribute the increase in the number of cases between 16:01-24:00 to the fact that most people leave work, and the rate of heavy alcohol consumption is high during those hours.

In the study conducted by Meral et al. [4], patients were most admitted to the hospital with gunshot wounds in April (13.2%) and May (11.6%), whereas in our study, gunshot wounds most occurred in November. While Meral et al. [4] showed that 14.6% of the cases were injured in more than one body part, we found that this rate was 41% in our study. Similar to the other studies [3, 4], lower extremity was the most common site of injury in this study.

There are several studies on the effectiveness of scoring systems to predict survival in patients injured by firearms [1, 3, 13]. GCS, ISS, RTS and TRISS trauma scores are among the important scoring systems in predicting prognosis and mortality in emergency situations [5, 6, 13]. Traditionally, surgeons have analyzed trauma mortality to assess the quality of treatment and the effectiveness of care. The implementation of the TRISS scoring system in developing countries with western norms has not been widely reported [17]. The true incidence of injury-related deaths is generally higher in developing countries, which can be attributed to inadequate trauma care, and the quality of prehospital care, including the elapsed time until transportation to a hospital [17, 18]. In this case, the precaution to be taken should improve the pre-hospital first intervention phase and reduce the time until definitive treatment. In developing countries, all studies based on TRISS do not include ED deaths. It is advocated that the TRISS scoring system will be a comparative audit by showing differences in outcome between hospitals in developing countries and act as a catalyst to encourage changes that will improve performance [17]. Several studies have suggested that a relationship exists between injury severity and death in trauma patients [19-21]. In this study, the mean TRISS score for survival prediction for penetrating trauma was 88.59%. Similar to the literature [3], in patients who died, GCS, RTS and TRISS were significantly lower and ISS was significantly higher compared to the surviving patients. We think that trauma scores provide information about the course of the disease and affect the treatment of the casualty.

Studies reported the rates of extremity fractures due to gunshot wounds as 59%, 34.5% and 56.7% [3, 11, 22]. In our study, there were four fractures in the upper and 15 fractures in the lower extremities, as determined by radiological methods.

Urgent intervention is required when arterial damage occurs in the lower extremity, as it can result in limb loss or a lethal injury [11, 23]. Dorlac et al. [24] found that more than half of the patients who were injured by firearms died from excessive blood loss due to artery damage in the lower extremity. In the study conducted by Engelmann et al. [22], neurovascular injuries were detected in 43.1% of patients. In this study, two patients with upper extremity injuries had radial artery and one patient with lower extremity injury had crural artery injury. Erythrocyte suspensions were transfused to two patients, and no death occurred due to extremity artery injury. Three patients had nerve injury (sciatic nerve in two patients, peroneal nerve in one patient) due to lower extremity trauma. It should not be forgotten that extremity traumas are life threatening due to the vascular and neural networks in this area and the anatomical neighborhoods of these structures.

In many studies, patients with gunshot injuries were mainly consulted to the Orthopedics & Traumatology Department [1, 3, 4], which was attributed to the prevalence of extremity injuries. This was followed by the plastic surgery department. In a cross-sectional study on gunshot wounds in ED patients, 7% of patients were admitted to the ICU [25] while this rate was 14.8% in our study.

Studies on gunshot wounds reported higher mortality rates than this study [3, 13]. Similar to the literature, in this study, deaths due to gunshot wounds generally occurred within the first day [3, 26]. Turgut et al. [1] found that the ISS of patients who died were significantly higher than those of survivors. Norouzi et al. [19] reported that an increase in ISS above 25 was directly related to an increased risk of death in injured patients. In our study, the injury severity score of six patients who died were above 25. As expected, high ISS is useful in predicting prognosis and mortality in patients with gunshot wounds.

There are many factors affecting morbidity and mortality in firearm injuries. Although bullets cause small holes in the skin, they can cause serious injuries associated with high mortality, especially in the head, thorax, and abdomen [3, 4, 27, 28]. Research emphasized that patients with abdominal injuries that cause high mortality should be intervened early and the hemorrhage should be controlled [27, 28]. In this study, the findings showed that two of the patients who died had isolated severe abdominal injuries and one had an isolated severe head-neck injury. Also, one patient who died with thoracic injury had accompanying head-neck and extremity injuries and the other patient had a concomitant abdominal injury.

Limitations

Limitations of our study included the lack of available information on morbidity and mortality after hospital discharge and the small number of the patients. It is recommended that further studies be performed with a larger number of patients.

Conclusion

The incidence of hospital admissions due to gunshot wounds, and the related mortality rates has increased over recent years. Gunshot wounds can cause serious injuries associated with high mortality, especially in the head, chest, and abdomen. This study suggests that the GCS, ISS, RTS and TRISS trauma scores systems can be useful in predicting prognosis and mortality rates in gunshot wounds.

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